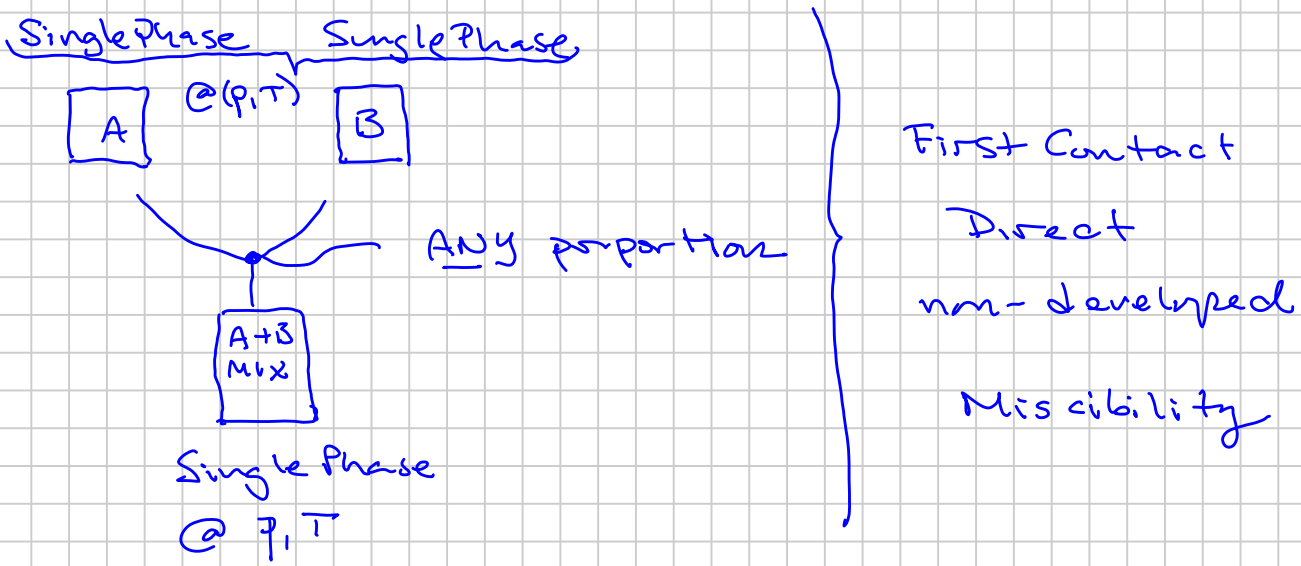
multiple mixing / VLE "stages"

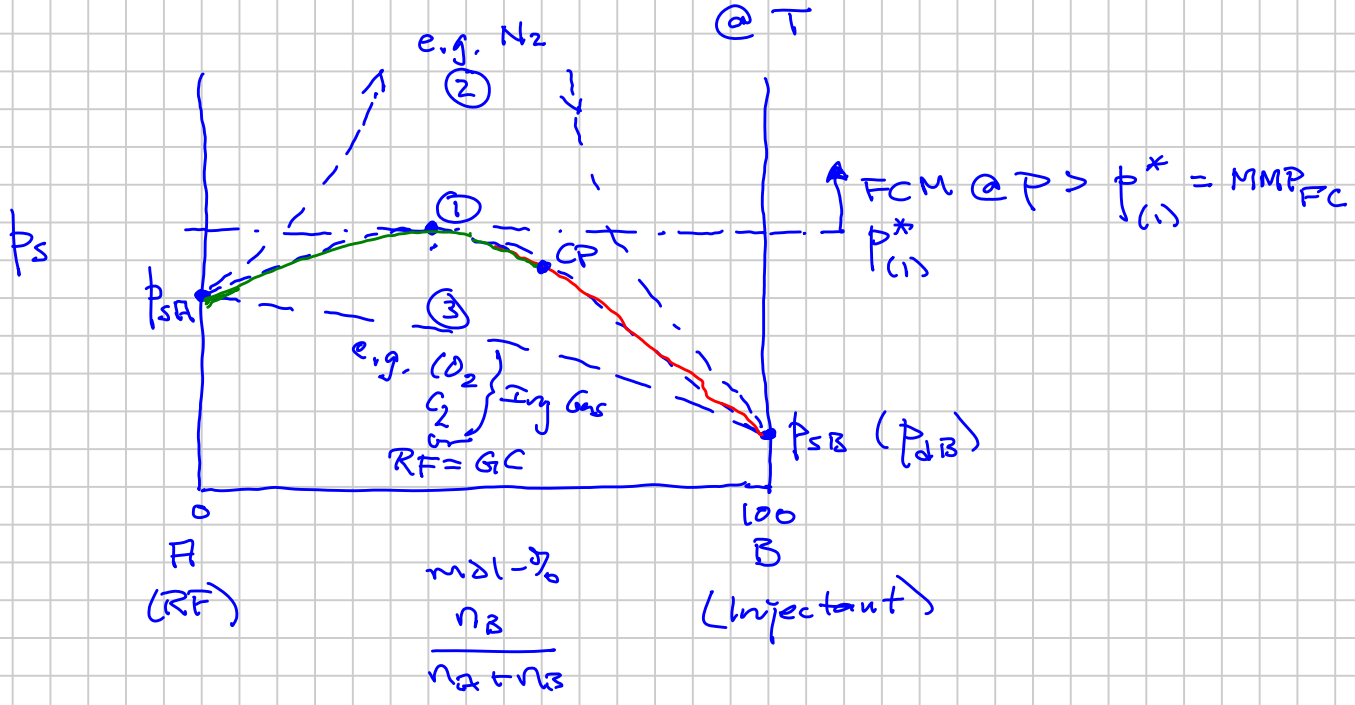
DEVELOPED MISCIBILITY

Note Title 3/14/2018



FCM: (Sensor e.g.)

p-composition p-x p-z diagram @ T



① Most common

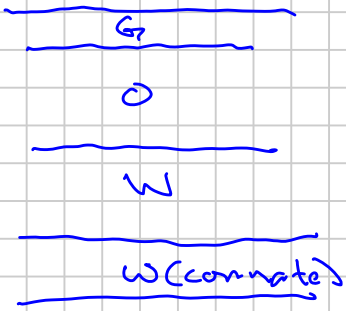
A: RO B: HC (Sep) Gas

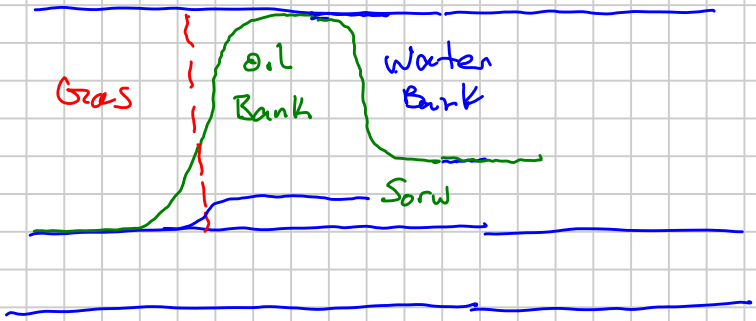
What's the big deal about a "miscible" process

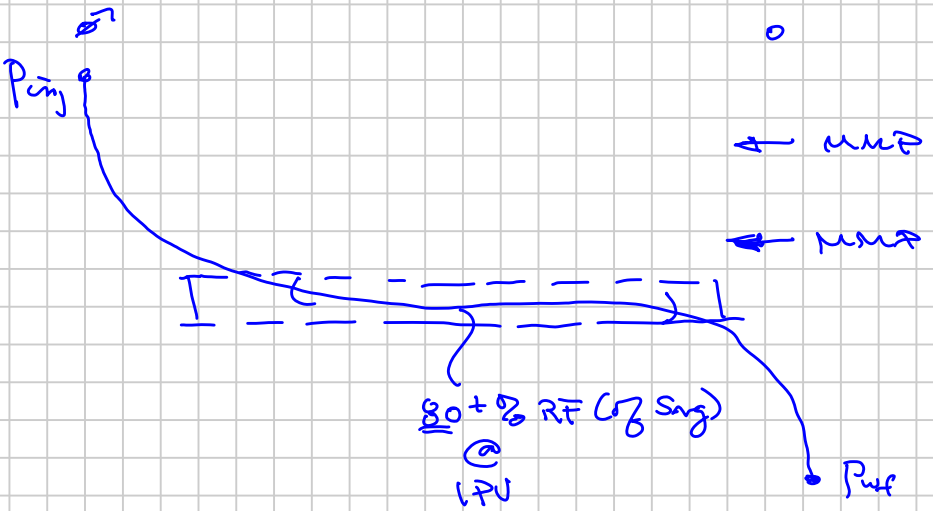
⇒ near-100% microscopic (pore level) RF

$S_{oi} \rightarrow S_{org} \rightarrow \equiv$

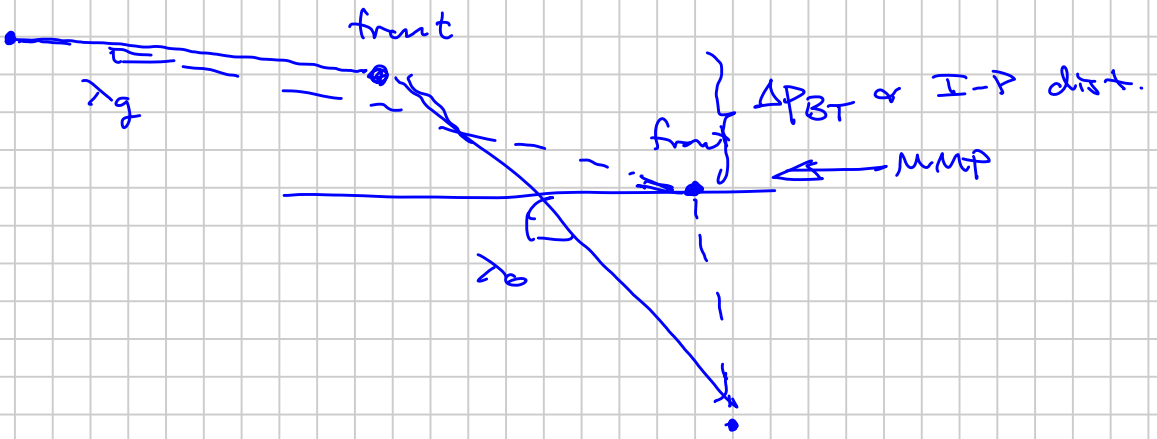
Post WF





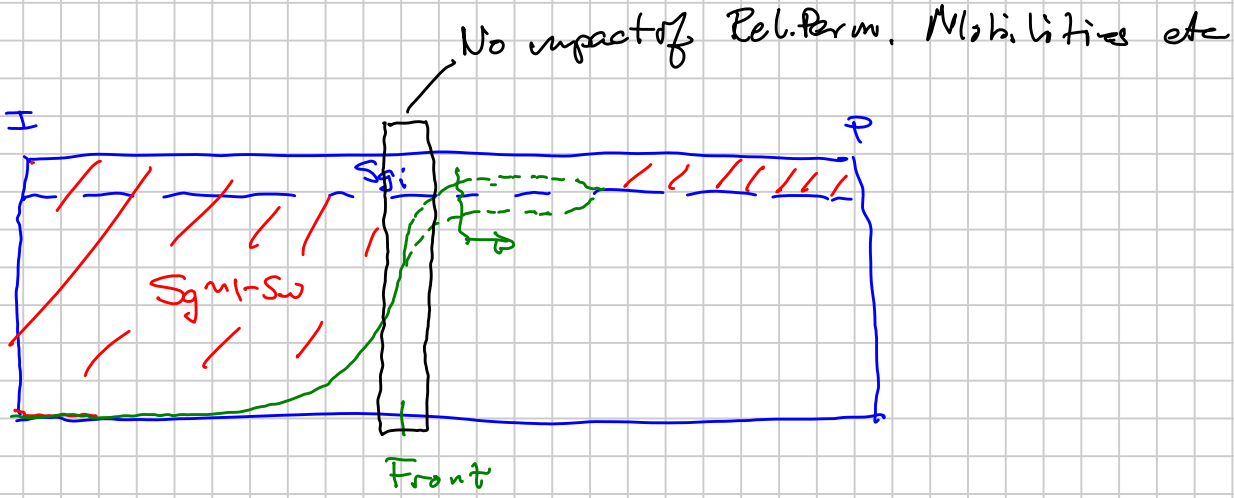


μEOR



MM $P_{C/V}$ < $P_{b_{RO}}$ = 4000

3200



Developed Miscibility Mechanisms

Short History (~1985): SPE Monograph Stalkup ('85)

(1) Vaporizing Gas Drive (VGD)

(2) Condensing Gas Drive (CGD) * 1985

(3) FCM (Gas-G.C. | Chase Gas – Inj Gas)

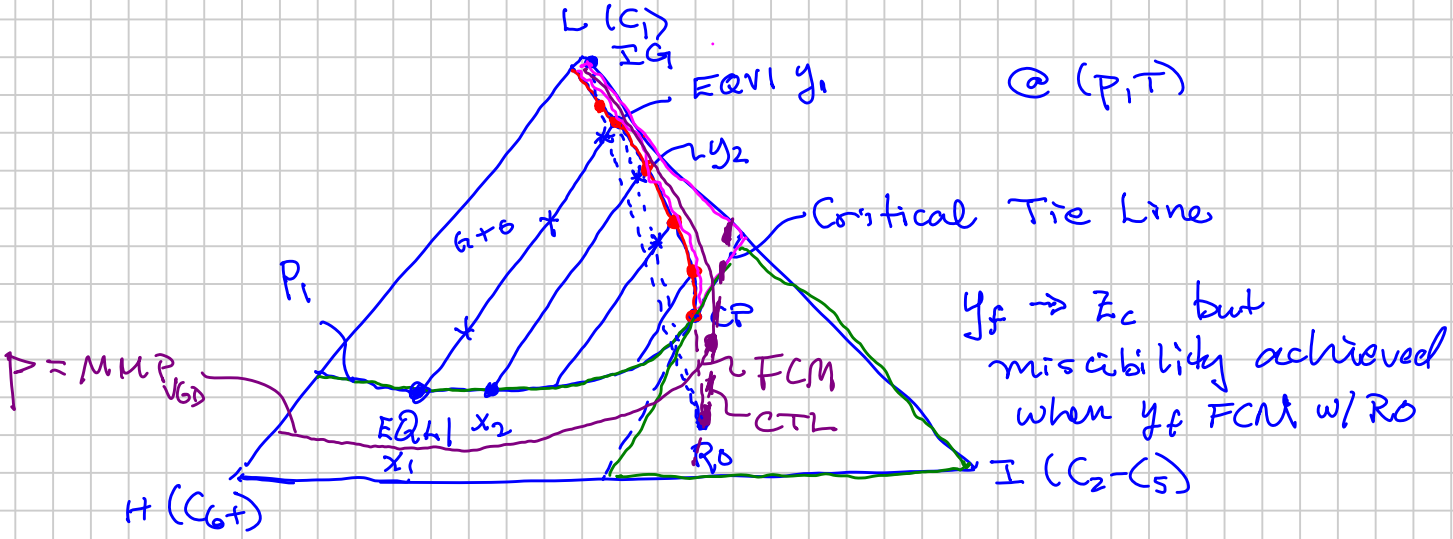
VGD:

(a) Lighter Oil / Condensate
- Rel. High % C_3-C_{12} in the "oil" } readily
- —"— C_2-C_6 —"— } moved from oil to inj. gas

(b) Inj. Gas very lean (C_1-rich, N_2)

(c) Rel. Higher pressures to reach miscibility
i.e., $MMP_{VGD} \gtrsim 4000-6000$ psia

Concept: Transform a non-equilibrium injection gas into a highly enriched (C_2-C_{10}) HC frontal gas that itself is FCM miscible with the in situ oil (condensate).



$y_f \rightarrow z_c$ but miscibility achieved when y_f FCM w/ R_0

Characteristics of VGD

(1) To achieve miscibility IGR & RO compositions MUST lie on opposite sides of the critical tie line.

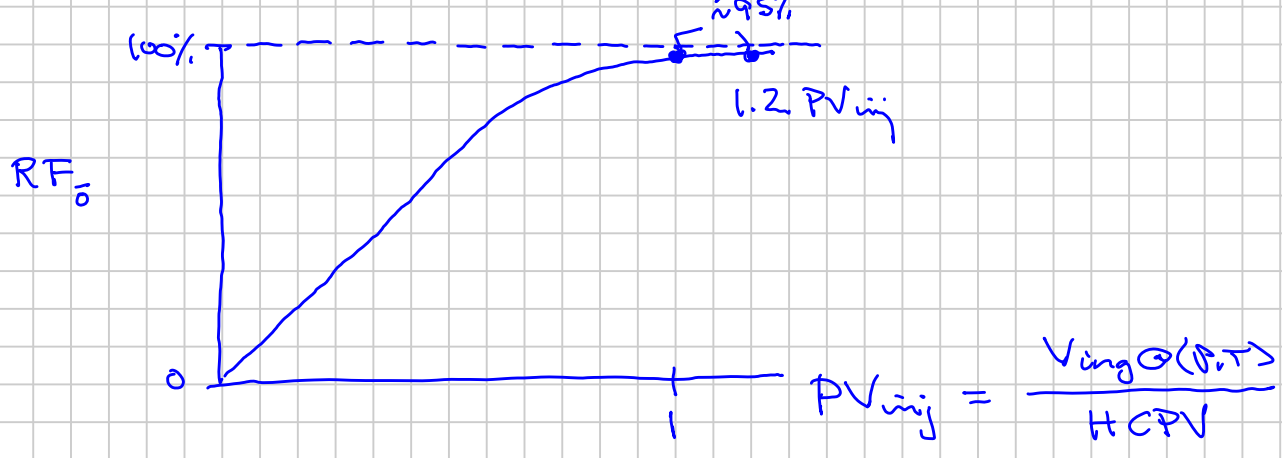
(2) Miscibility is always achieved at the gas "front" ($S_g = 0$)

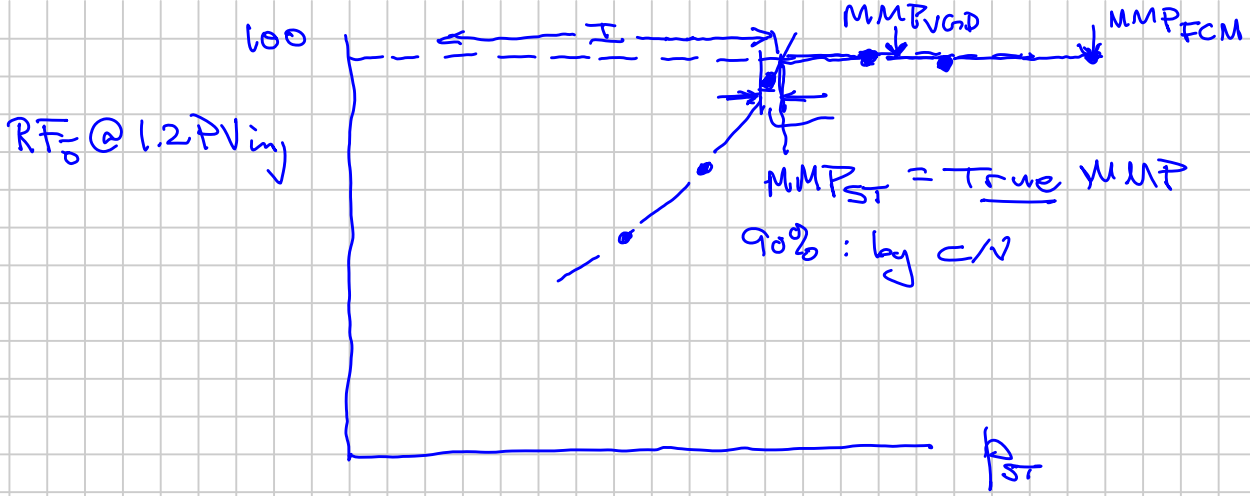
- S_g must be = 0 at/ahead of the front

(3) MMP_{VGD} is where the RO composition is on the critical line

(4) Most situations you can still develop miscibility a $p < MMP_{VGD}$ – by the C/V mechanism. But you can't "see" this from a ternary diagram.

Developed Miscibility is determined experimentally by a slimtube (1D, nearly dispersion-free) displacement.





MMP

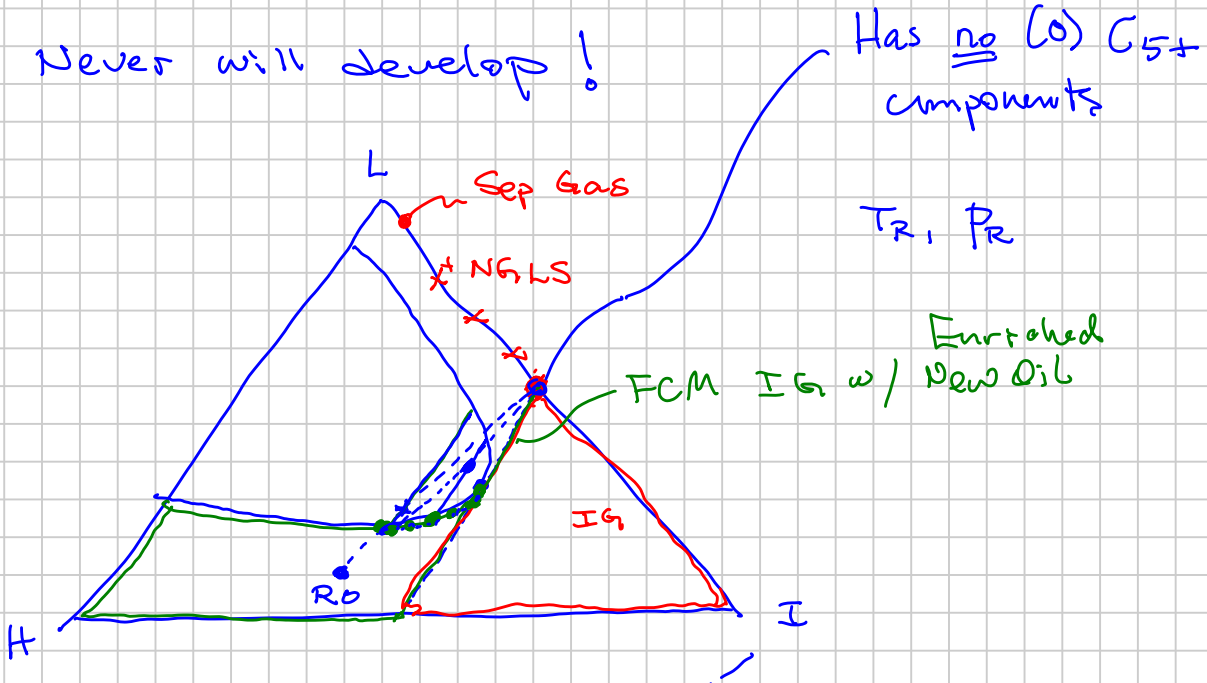
MME = Enrichment Level to get MMP = P_R

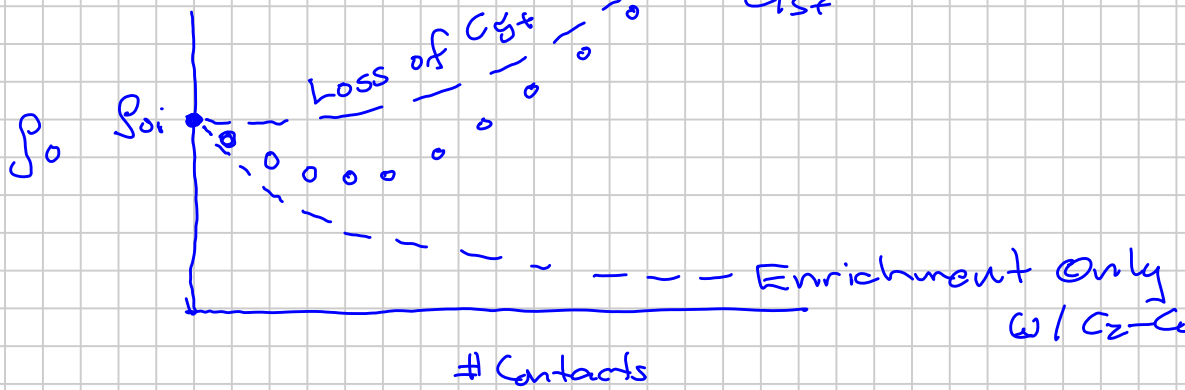
C_2–C_5 addition to

Sep. Gas

MME (T_R, P_R, "NGL", y_{spi}, API)

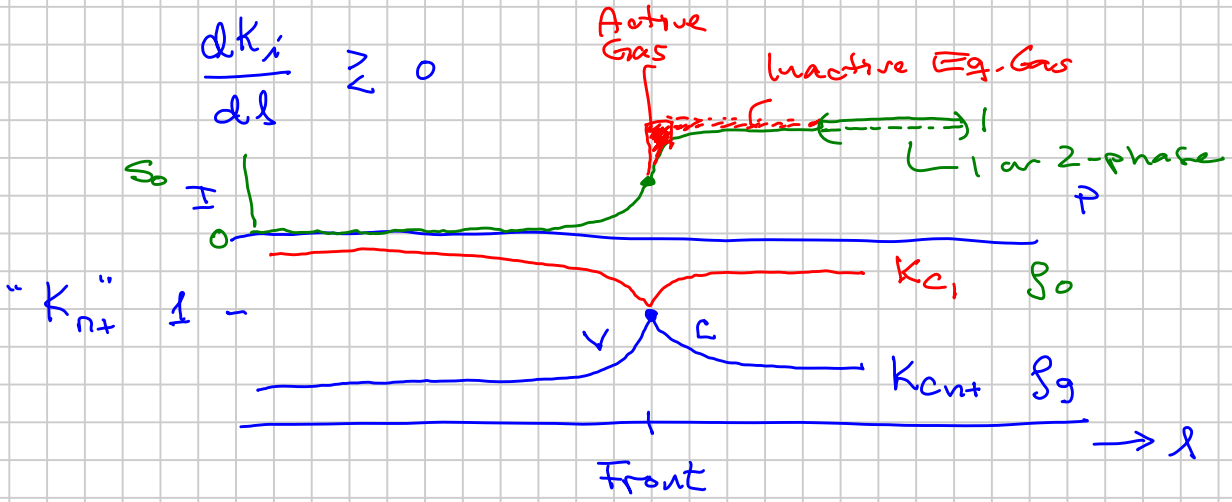
CGD: Never will develop!





1D numerical simulations w/ a well-tuned EOS that showed why Miscibility was achieved at ~low p's (3000 psia) in the slimtube tests.

⇒ Condensation & Vaporization



Signature of C/V miscible mechanism at $p \geq MMP_{C/V}$

$p \to MMP_{VGD}$: Right side ("C") disappears